II. TRENDS IN DOCTORAL SCIENCE AND ENGINEERING UNEMPLOYMENT

INTRODUCTION

What have been the past trends in doctoral science and engineering unemployment? What are they likely to be in the future? These questions, frequently asked by planners and policy makers, are addressed in this section through a discussion of the trends between 1973 and 1995[6] and a brief discussion of past attempts to predict unemployment trends.

PAST TRENDS

In 1993, the unemployment rate for the doctoral science and engineering population was 1.6 percent, somewhat higher than the 1973 rate of 1.2 percent[7] —a statistically significant difference.[8] In both years, the doctoral unemployment rates were less than a quarter of the national rates of 7.1 percent in April 1993[9] and 5.0 percent in April 1973.[10] The 1995 doctoral unemployment rate (1.5 percent) was virtually unchanged from the 1993 rate, even though the overall unemployment rate declined considerably (to 5.7 percent).

Although the overall doctoral unemployment rate in 1993 was much lower than the rate for the general population, it is important to note that the 1993 rate was the highest observed rate to date in the biennial SDR.[11]

This is consistent with observations that unemployment in subgroups of the doctoral science and engineering population was unusually high in the early 1990s.[12]

The relatively low rate of unemployment in the doctoral science and engineering (S&E) population is also consistent with the fact that unemployment rates decrease as educational level rises in the general population. Three major observations can be made about the importance of education level by comparing SDR unemployment rates with total population unemployment rates by level of education between 1973 and 1995 (chart 1).

- During this period of time, education level and unemployment had a strong negative correlation. The trend line for the doctoral science and engineering population lies consistently below that for the college-educated population.

- The unemployment rates of the doctoral population fluctuated less than that of other educational groups. The ratio of maximum to minimum unemployment rates observed over this time was 1.8 for the doctoral population compared to 2.1 for the college population and approximately 3.0 for the populations with high school or lower levels of education.

- There is no apparent association between unemployment rates in the doctoral science and engineering population and those in the total population ($r = -.08$).[13] Thus, predictions of future unemployment rates in the economy as a whole are not relevant for the population of doctoral scientists and engineers.

The observed relationship between degree level and unemployment rate is consistent with the findings of the 1972 National Science Foundation's (NSF) unemployment study, which reported data on scientists

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[6] The trend data include 1995 SDR data that became available during final revisions of this report. It was not feasible to incorporate fully the new data into this report in a timely fashion. As noted in the concluding section, the new data will provide considerable opportunities for expanding the analyses in this report.

[7] Maxfield, Ahearn, and Spisak, p. 1.

[8] Throughout this report "statistically significant" is used to mean statistically significant at the .05 level. See the Technical Notes for specific information on how these tests were done.

[9] U.S. Department of Labor, p. 31. Note: this is based on non-institutionalized population aged 16 and over.

[10] Bureau of Labor Statistics (BLS), statistics on seasonally adjusted unemployment rates for the civilian population, aged 16 and over downloaded from the BLS Web site (http://stats.bls.gov/).

[11] National Science Foundation 1994, p. 8 and NSF 1991, p. 18. See the Technical Notes for a discussion of the likely impact of changes in methodology on the trends.

[12] See, for example, Greene, Hardy, and Smith, p. 59; Gruner, Langer, Nelson, and Vogel, p. 25; Magner, p. A19.

[13] For all other educational groups, the correlation between the group's unemployment rate and the total rate was positive and statistically significant.

Chart 1. Unemployment rates of persons with doctoral degrees in science and engineering and persons 25 to 64 years of age in the overall population, by educational level: 1973–95
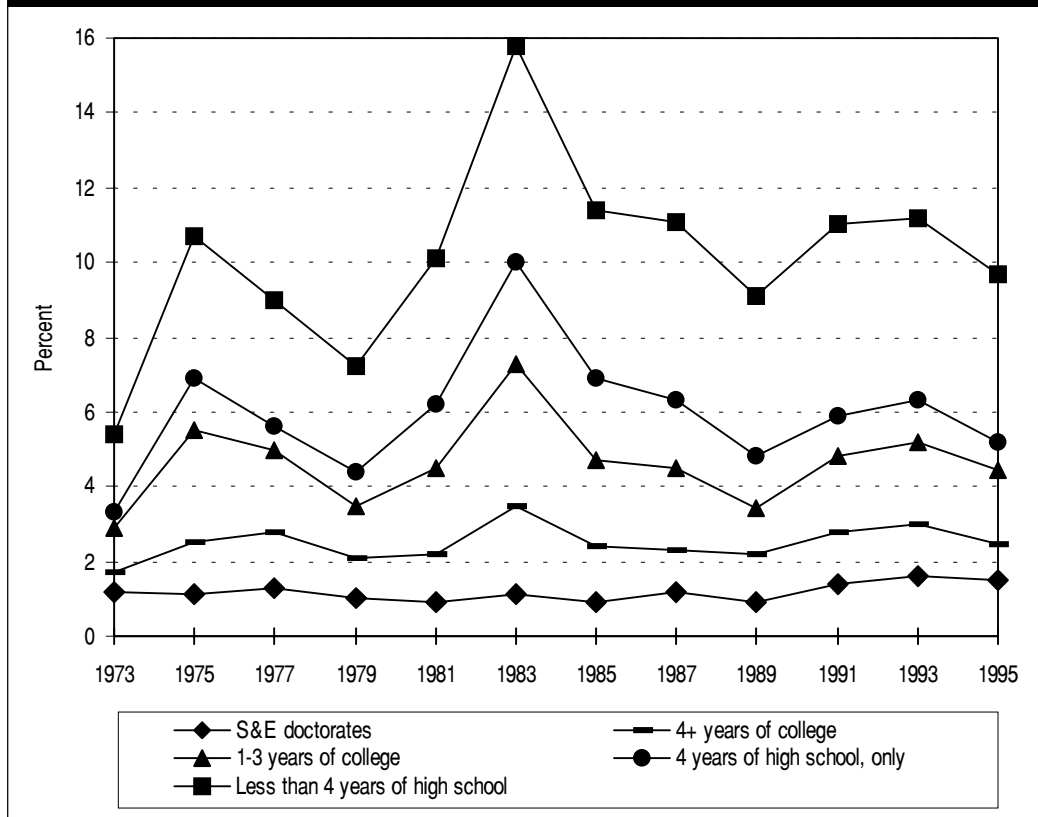
NOTE: Data for the doctorate population in 1991 and 1993 are not strictly comparable to each other or to those in preceding years.

SOURCES: Doctoral statistics from National Science Foundation/SRS, Survey of Doctorate Recipients. General population figures from Bureau of Labor Statistics, BLS, Current Population Survey.

and engineers separately. In that study, the unemployment rate for doctoral scientists was 1.4 percent compared with 3.7 percent for those holding master's degrees and 3.5 percent for those with bachelor's degrees. For engineers, the corresponding unemployment rates were 1.9 percent, 3.2 percent, and 2.8 percent, respectively.[14] Similarly, in 1993, the unemployment rate was 1.6 percent for those with a doctorate in science and engineering from a U.S. institution, 2.7 percent for those with a master's degree in science and engineering, and 4.0 percent for those with a bachelor's degree in science and engineering.[15]

Another view of the unemployment trends in the population of individuals with doctorates in science and engineering can be obtained by examining the ratio of unemployment in the overall U.S. labor force to that in the doctoral S&E labor force (chart 2). In both 1973 and 1995, the ratio of total unemployment to doctoral unemployment was relatively low, approximately 4:1. In the intermediate years, the ratio reached a maximum value of approximately 9:1 in 1983, the peak year of unemployment in the country.

FUTURE TRENDS

Predicting doctoral science and engineering unemployment requires specialized prediction models, because of the negligible association between unemployment in the doctoral science and engineering labor force and that in the general population. Although there

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[14] NSF 1972, pp. 15 and 63.

[15] Data from special tabulations of the 1993 Science and Engineering Statistical (SESTAT) database that integrates data from the Survey of Doctorate Recipients with data from the National Survey of Recent College Graduates and the National Survey of College Graduates (http://www.nsf.gov/sbe/srs/stats.htm).

Chart 2. Ratio of April unemployment rates of U.S. civilian labor force 16 years and older to April unemployment rates for those with doctoral degrees in science and engineering: 1973–95
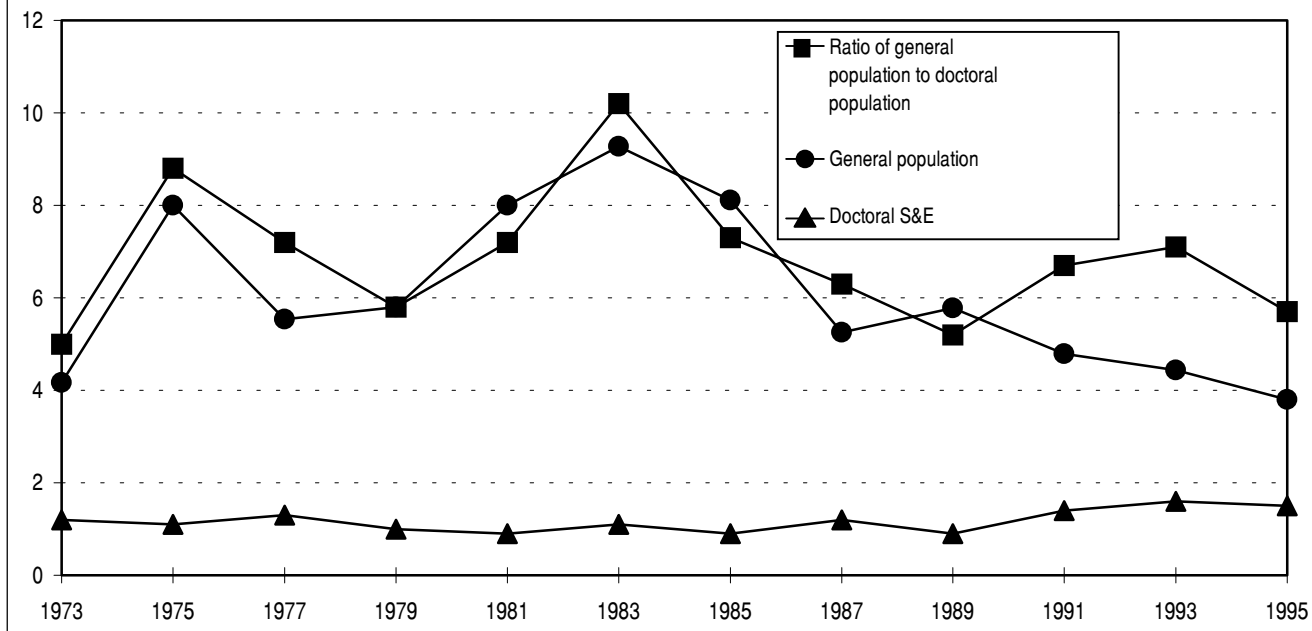
have been attempts to develop such models, the work is difficult and thus far has produced no evidence of success.

Relevant literature on this topic was summarized in the *Report of the Ad Hoc Working Group on the Supply of Science, Engineering, and Mathematics (SEM) Professionals* (1993). The report concluded, "It is not currently possible and will probably never be possible to predict with a high degree of accuracy shortages or surpluses of scientists and engineers several years into the future." A similar sentiment was echoed in a more recent publication (Tobias et al., p. 16), "Given the time lag in producing scientists,…it is particularly hard to predict, no less adjust, supply and demand."

Indeed, it can be argued that publicizing job market predictions results in the predictions becoming invalid. In other words, a prediction that a field will be "hot"

several years from now increases the attractiveness of the field. This increases the supply of individuals capable of filling positions in the field, which, in turn, prevents the predicted shortage from materializing.

CONCLUSIONS

Past trends indicate that there is little, if any, association between doctoral science and engineering unemployment and unemployment in the general population. Attempts to develop specialized models to predict doctoral science and engineering unemployment have proven to be unsuccessful. Accurate predictions may never be feasible given that the predictions themselves are likely to alter the balance of supply and demand.